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WM. A. TAYLOR, Chief

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THE RAISIN INDUSTRY.[1]

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ORIGIN AND GROWTH OF THE INDUSTRY.

With the exception of very limited quantities produced in Arizona, Utah, and New Mexico, all the raisins grown in the United States are produced in California.

The first introduction of raisin varieties into California was by Col. Agostin Haraszthy. In 1851 he grew muscatels from the seed of imported raisins. On March 25, 1851, he imported the Alexandria (*Muscat of Alexandria*) and in 1861 the Gordo Blanco (muscatel) and Sultana from Spain and the White Corinth and Red Corinth from the Crimea. Another importation of Muscat of Alexandria was made by A. Delmas in 1855 and planted near San Jose, Cal. The first raisins appear to have been produced in the San Bernardino Valley, but the industry soon spread northward. G. G. Briggs, of Davisville, imported muscatel grapes from Spain, while R. G. Blowers, of Woodland, Cal., started a raisin vineyard of Gordo Blanco (muscatel) in 1863 with cuttings received from Col. Haraszthy. The Briggs and Blowers vineyards were the first in the

[1] This bulletin has been prepared for the purpose of answering questions relative to the raisin industry of the United States. The pruning, training, cultural methods, and varieties suitable for raisin purposes, as well as the methods of harvesting and drying the grapes and the curing and processing of the raisins, are described.

State to successfully produce raisins. This was in 1867, but it was not until 1873 that their raisin crops became an important factor in the market, when they amounted to nearly 6,000 boxes. In 1873 Judge J. W. North planted the first Alexandria (*Muscat of*) grapes at Riverside, and three years later raisin-grape growing had become general. R. G. Clark planted Muscats in El Cajon Valley in 1873, but most of the vineyards of that district were not planted until 1884 to 1886. In the fall of 1873, 25 acres of Alexandria were planted in the Eisin vineyards near Fresno, and in 1875 the McPherson brothers made their first plantings near McPherson. The industry grew so that Robert McPherson, the largest grower, became at one time not only the largest packer and dealer in the district but the largest then in the State. In 1876 W. S. Chapman imported material of the best obtainable Muscat grapes for the Central California Colony in Fresno County, which, however, proved to be the same as those planted in 1873. In 1876 and 1877 T. C. White planted the Raisina vineyard with Gordo Blanco (muscatel), and in 1877 and 1878 Miss M. F. Austin planted the same variety at the Hedge Row vineyard. Cuttings of Sultanina were received in 1878 by W. T. Thompson, of Yuba City, Cal., from Elwanger & Barry, Rochester, N. Y., and described by them as the Lady de Coverly, from Constantinople. The so-called Feher Szagos is said to have been found growing in California and was christened by a Hungarian, who claimed to recognize the variety as one he had known in his native land. The Butler vineyard, which was then one of the largest, was planted in 1879. Col. William Forsythe began raisin growing in 1881 or 1882.

In 1873 the entire State of California produced 120,000 pounds of raisins; in 1875, 220,000 pounds; in 1880, 1,500,000 pounds; and in 1885, 9,400,000 pounds. In 1887 Fresno County produced 7,000,000 pounds, and raisin growing was recognized to be its leading industry.

The figures in Table I, taken from the reports of the California State Board of Agriculture and the United States Department of Commerce, showing the California crop and the quantity and value of exports and imports, will prove interesting and serve to show the growth of the industry. As the practice has been not to produce more than enough raisins to supply the demand, the difference between the crop produced and the quantity exported will show the consumption of home-grown raisins in this country. It is also of interest to note, as shown in this table, that in general as the production of raisins in California has increased exports have increased and imports have correspondingly decreased.

TABLE I.—*California raisin crop compared with the quantity and value of exports and imports of raisins in the United States.*

Year.	California crop (pounds).	Exports for fiscal year ending June 30.		Imports for fiscal year ending June 30.	
		Pounds.	Value.	Pounds.	Value.
1885	9,400,000	.....	.....	38,319,787	$2,661,669
1890	38,000,000	.....	.....	36,914,330	1,997,103
1895	91,000,000	.....	.....	15,921,278	651,420
1900	90,000,000	2,415,456	$139,689	10,309,498	531,124
1905	87,000,000	7,054,824	372,087	4,041,689	273,031
1910	115,000,000	8,526,114	417,403	5,042,683	296,047
1911	120,000,000	18,659,992	1,069,300	2,479,220	237,422
1912	185,000,000	19,949,046	1,351,986	3,255,861	295,466
1913	130,000,000	28,120,507	1,512,642	2,579,705	241,630
1914	182,000,000	14,766,416	997,575	4,554,549	309,511
1915	250,000,000	24,845,414	1,718,547	2,808,806	238,958

About 110,000 acres are devoted to raisin growing. Of the 58 counties in California, 11 produce raisins in commercial quantities. The raisin output of the State in 1914 was 182,000,000 pounds. The estimated quantity produced in each county is shown in Table II.

TABLE II.—*Estimated production of raisins in California, by counties, in 1914.*

County.	Crop.	County.	Crop.
	Pounds.		*Pounds.*
Fresno	106,000,000	Yolo	2,500,000
Tulare	30,000,000	Kern	1,600,000
Kings	24,000,000	Colusa	900,000
Sutter	6,000,000	Los Angeles	800,000
San Bernardino	4,600,000		
San Diego	3,200,000	Total	182,000,000
Madera	2,400,000		

It will be seen from this that Fresno County alone produces nearly 60 per cent of the entire raisin output of the State. It was in 1892 that the California raisin crop first equaled that of Spain. California now produces about three times as many raisins as Spain.

At present the annual consumption of raisins in the United States is less than 1½ pounds per capita. Were we to consume as much as Great Britain, or about 5 pounds per capita, the industry in this country could be quadrupled without causing overproduction.

SOME FLUCTUATIONS IN THE INDUSTRY.

From 1889 to 1893 an average of 5 cents a pound was realized by the raisin growers, and the industry was very profitable. An era of falling prices then began and continued until in 1897 raisins were quoted as low as three-fourths of a cent a pound. Many growers gave up in despair, and thousands of acres of vines were

plowed up. The growers who persisted saw that to succeed they would have to cooperate. In 1898 the California Raisin Growers' Association was founded under the direction of the late M. Theo. Kearney, owner of the largest raisin vineyard in California. In 1903 prices again fell, the association was unable to sell the raisins it had contracted for, and many growers received no returns. As only 30 per cent of the estimated acreage had been signed up, all contracts were returned August 1, 1904, and the association went into the hands of a receiver. Another attempt made in 1904 to organize the growers resulted in the incorporation on May 6, 1905, of the California Raisin Growers' Co., with M. F. Tarpey as president. The company was never well supported by the growers and dissolved after nearly a year's existence.

On November 24, 1911, the California Raisin Exchange, planned by W. R. Nutting, was organized under the California membership association law. Its first object was to map all the vineyards and orchards in the central California fruit district, and its ultimate aim was to maintain an open place of exchange for the sale of raisins and dried fruit.

What was at first styled "The Million Dollar Co." was legally organized on November 15, 1912, as "The California Associated Raisin Co." by the election of 25 trustees and with $401,000 cash capital, subscribed by growers, which was increased to $750,000 before April 1, 1913, and has since been increased to $1,050,000. It was incorporated on April 1, 1913, for $1,500,000. In 1914 6,500 growers contracted their crops with it.

Active effort is being made by this organization to bring raisins into more general use.

On April 30, 1915, an entire carload of raisin bread was distributed free at the Panama-Pacific Exposition from the Pure Food and California Buildings.

A distinguishing feature of the raisin industry is that the vineyards consist mainly of individual vineyards of 10 to 50 acres each, although there are some which contain from 100 to several hundred acres, and a few from 500 to 1,000 acres or more each. It will not be amiss to state that a peculiar relationship has for some time existed in the raisin-producing section between the grapes used for raisins and those used for wine and brandy. For example, Alexandria, the leading raisin grape, always has a heavy second crop of grapes, which is practically all made into wine and brandy, the raisins being cured from the first-crop grapes. It is also the endeavor to cure only sufficient raisins to supply the demand, and the grapes not required for raisins are made into wines and brandies. The product of about 110,000 acres is at present converted into raisins to meet the demand for about 182,000,000 pounds per annum.

Many changes have occurred since raisin growing became an industry in Orange County, and Fresno has become the center of the industry, as the conditions there are exceptionally suited to the growing and curing of raisins.

RAISIN-VINEYARD SOIL.

Raisin-vineyard soils vary considerably, the deep-gray alluvial bottom land being considered the best. In this connection the mechanical analysis of the soil in the department experiment vineyard near Fresno, made by the Bureau of Soils, and shown in Table III, will prove interesting.

TABLE III.—*Analysis of the soil of the Fresno Experimental Vineyard at Fresno, Cal.*

Description and depth of soil.	Mechanical constituents (per cent).							
	Coarse gravel.	Fine gravel (2 to 1 mm.).	Coarse sand (1 to 0.5 mm.).	Medium sand (0.5 to 0.25 mm.).	Fine sand (0.25 to 0.1 mm.).	Very fine sand (0.1 to 0.05 mm.).	Silt (0.05 to 0.005 mm.).	Clay (0.005 mm. and smaller).
Brown sandy loam:								
0 to 12 inches	0.58	1.2	9.8	6.7	18.4	12.0	33.2	19.7
12 to 24 inches	.71	.9	9.1	6.9	17.8	12.3	32.5	21.4
Sandy loam:								
24 to 36 inches	.51	.6	8.3	7.8	19.9	12.9	27.1	23.5
36 to 48 inches	.35	.9	8.8	6.0	13.7	13.1	36.3	21.4
Free sandy loam:								
48 to 60 inches	.11	1.2	14.2	8.6	22.4	15.7	26.5	11.1

Of this type of soil about 75,000 acres near Fresno, 6,000 near Stockton, and about 265,000 in the Sacramento Valley have been mapped by the Bureau of Soils. For a further description of the soils, see Bureau of Plant Industry Bulletin 172 and the surveys of the Bureau of Soils.

PREPARATION OF SOILS.

In the raisin-producing sections of California the country is naturally so level that not much grading is necessary. After the land has been leveled where needed it should be well prepared. If virgin soil is to be used, it will allow the field to be put in better shape if a crop of grain is grown on it the season before planting. After being plowed and subsoiled, it should be thoroughly harrowed and clod-crushed with a drag or roller. In the early stages of the industry most of the vines were planted 7 feet apart each way (Pl. I, fig. 1). The tendency now is to plant farther apart, some planting 8 feet apart each way (Pl. I, fig. 2), others 6 by 10 feet, 9 by 9 feet, 8 by 10 feet (Pl. I, fig. 3), or even wider distances apart. Trellises are the exception (Pl. II, fig. 1); usually stakes are simply used to support

the vines (Pl. II, fig. 2). This enables the growers to plow and cultivate lengthwise and crosswise. Of late years, since the proper method of pruning Sultanina has become better known, there is a tendency toward trellising. The vineyards are plowed twice annually. In the first plowing the soil is thrown away from the vines (Pl. I, fig. 3), and in the second it is thrown up to them again (Pl. I, fig. 1). Frequent cultivations are given early in the season, all culture being abandoned after the spring rains are over.

Crops can be grown without irrigation, but it has been practiced largely because it increases the size of the fruit and therefore also increases the yield. Trouble has been experienced in some localities on account of the lands becoming waterlogged from irrigation.

PRUNING METHODS IN RAISIN VINEYARDS.

Three methods of pruning are practiced with raisin varieties in this country. These are spur, cane, and spurring laterals on canes, the methods used differing with the varieties. All grape-pruning systems have, however, the one underlying principle that the grape usually bears its fruit on shoots from wood of the previous year's growth. The pruning should, therefore, be such as to renew the wood at a given point from year to year, thereby regulating its production and keeping the plant thoroughly shaped and under constant control.[1]

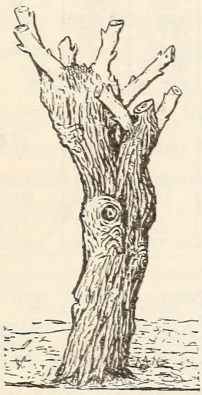


FIG. 1.—A grapevine pruned to spurs.

THE SPUR, STOOL, OR SHORT PRUNING SYSTEM.

The simplest and cheapest method and the one extensively used in California with the stockier varieties of Vinifera grapes is the spur system, otherwise known as the stool or short pruning system. By this method the body of the vine is grown to the desired height and shoots are permitted to grow from only the two uppermost buds. The two resulting canes are cut back in the winter to spurs of two eyes each. The following year these spurs are allowed to produce growth. The resulting canes are again cut back to spurs and all of them allowed to remain if the vine is strong enough. Thus the vine under ordinary conditions at the beginning of the fifth year consists of a trunk from which spring four or five arms, on each of which a cane has been cut back to a spur (fig. 1 and Pl. II, fig. 3). When the vine is pruned the following winter all, or nearly all, the outer canes that have grown from the spurs are entirely removed. The

[1] For full information on the pruning and training of vines, see Farmers' Bulletin No. 471, entitled "Grape Propagation, Pruning, and Training."

spurs of the last season are cut off just outside the inner canes, which are cut back to spurs, the pruning each winter after this being done to promote a regular system of spur renewal. As the vines become older and stronger and can stand more cropping, more spurs are left to increase the fruiting capacity of the plant. In course of time the arms of the respective spurs are renewed and entirely new arms and spurs are grown. The head of the vine should be kept well balanced and given a globular form if possible. Some varieties on which the lower eyes are not sufficiently productive may be improved by increasing the length of the spurs and the number of eyes, leaving four or even five eyes to a spur, according to the variety of the vine.

THE LONG, OR CANE, PRUNING SYSTEM.

The long, or cane, pruning system is also in general use in California. When vines are trained according to this system the fruit is borne on canes which are tied to a stake, the spurs which are left to grow from them producing canes for the following year. In pruning, the canes which fruited the previous year as well as the arms on which they grew are entirely removed, the canes produced from the spurs left the previous year furnishing the fruiting canes and spurs needed (fig. 2). In this manner the head of the vine is renewed from year to year, and as the plants grow older and stronger the fruiting capacity is increased by leaving more canes and spurs.

FIG. 2.—A grapevine pruned to canes.

The Sultanina bears well only when pruned to long canes. Provision should therefore be made for the growth of new canes from the stump, to furnish bearing canes for the following years. This is accomplished in pruning by leaving short spurs of one or two buds on the main stump from which to grow the canes. Frequently, however, the spurs are so shaded by the foliage on the fruiting canes that they do not always produce vigorous wood and often fail to grow. To remedy this, two methods are employed; namely, (1) bending and tying the fruiting canes to form a circle (fig. 3), and (2) training the fruiting canes on horizontal trellises. The first method diminishes the tendency of the sap to go to the end of the fruiting canes and causes a greater number of shoots to start on the lower parts of them. These shoots are not so strong, but are more fruitful. Another result of the bending of the canes is that the sap pressure starts strong

shoots from the spurs left for the purpose. These shoots are used as fruiting canes the following year, new spurs being left to grow canes for the next year. In the second method the pruning is the same and the same objects are accomplished, but a trellis is used on which the fruiting canes are placed in a horizontal position and tied to the trellis wires (Pl. II, fig. 1). The Sultanina variety also has a tendency to send out suckers, water sprouts, and sterile shoots. For that reason the vines should be carefully gone over several times after the young shoots start, to remove undesirable growths.

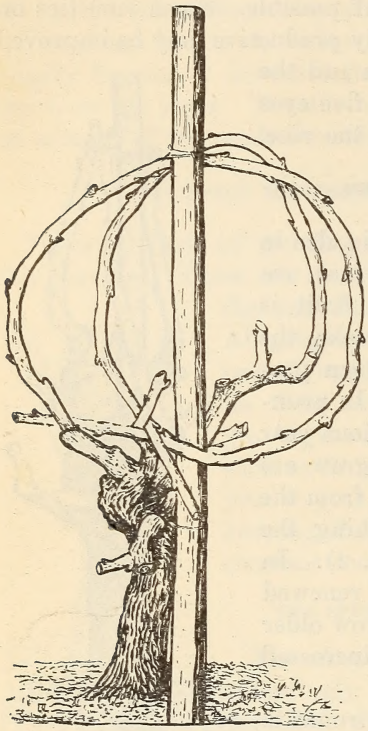


FIG. 3.—A grapevine pruned to long canes, the canes afterwards being bent in a circle on the support.

RAISIN VARIETIES.

The raisin varieties are all Viniferas, therefore they are not resistant to phylloxera, and for this reason they should be grown on phylloxera-resistant stocks to make permanent, durable vineyards.

The principal raisin variety grown is the Alexandria (Pl. III). This has numerous synonyms, but is so well known in this country as Alexandria that no other names need now be given.

Ripens midseason. Color yellowish green; when fully ripe, flushed with amber. Cluster straggling, long, loose, and never compact even when perfect. Stem long, reddish brown; pedicel thick, warty, yellowish, one-half inch long. Berry large, five-eighths by 1 inch long, tapering toward pedicel, sometimes slightly flattened at apex; surface smooth, yellowish green; bloom white; adherence excellent. Skin tough and thick. Flesh meaty, firm, fairly juicy. Seeds one to four, long, reddish brown. Flavor spicy, fruity, and rich. Vine robust, with small-furrowed, light-yellow wood, dotted with black. Leaves five-lobed, medium size, thick, leathery, smooth, rather deeply serrated, slightly elongated, light green, slightly glossy above, gray yellowish green underneath; veins thin, red at base; leaf stem longer than midrib of leaf; petiolar sinus open.

This is the most important raisin variety. It is also a very important shipping grape, as it carries well, looks well, and many ad-

FIG. 1.—CROSS PLOWING A MUSCAT VINEYARD.

FIG. 2.—A MUSCAT VINEYARD READY FOR PLOWING.

FIG. 3.—A SULTANINA VINEYARD AFTER PLOWING.

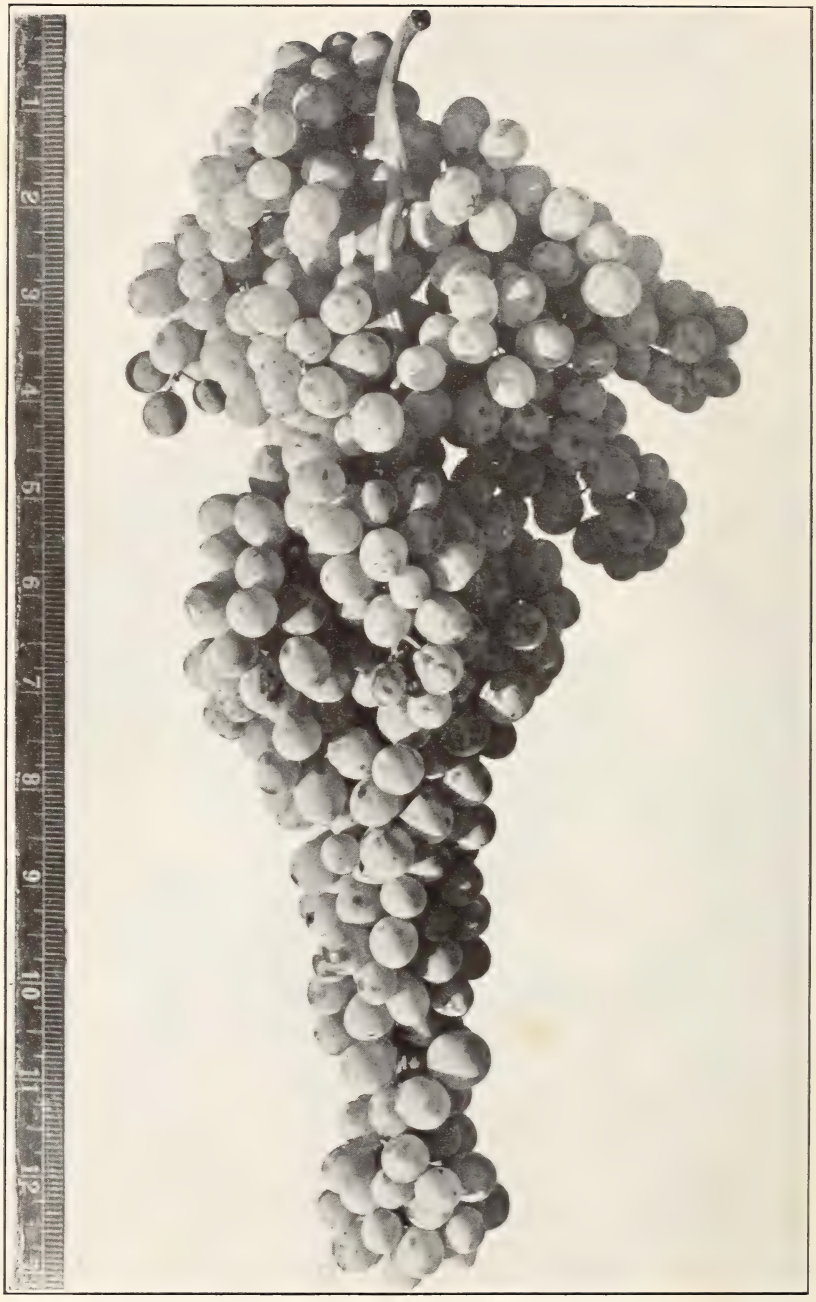
FIG. 1.—PRUNED SULTANINA VINES ON TRELLISES.

FIG. 2.—PRUNING SULTANINA VINES TO CANES.

FIG. 3.—PRUNING MUSCAT VINES TO SPURS.

A CLUSTER OF ALEXANDRIA (MUSCAT OF ALEXANDRIA) GRAPES.

(Two-thirds natural size.)



A CLUSTER OF SULTANINA (ERRONEOUSLY CALLED THOMPSON SEEDLESS) GRAPES.

mire its peculiar flavor. It seems to have been first cultivated by the Arabs.

The vine is fairly productive, but does not always set well. The laterals produce a heavy second crop and sometimes a third crop. The vine should be pruned to the spur system (fig. 1 and Pl. I, fig. 1). Tests made of this variety grafted on a number of resistant stocks so far show good congeniality to exist between it and Riparia × Rupestris 3309, Riparia × Rupestris 101, Dog Ridge, Riparia × Rupestris 101–14, and Berlandieri × Riparia 420–A, in the order named.

The muscatel Gordo Blanco, which has also been grown to a considerable extent in this country, resembles the Alexandria, differing from it principally in having a round berry and clusters more compact.

The Huasco and White Hanepoot are practically identical with Alexandria.

The Malaga and Feher Szagos (both wrongly named), which have been desiccated to a considerable extent in the past, are not now much used. Other large-berried varieties that have been dried in limited quantities will never figure commercially, it is thought, and for this reason are not mentioned.

Next to Alexandria, the Sultanina (Pl. IV and Pl. V, fig. 1; synonyms, *Sultanieh*, *Ezkerdeksis*, *Tchekirdeksis*, *Kechmich*, *jaune a grains oblongs*, *Conforogo*, etc., and erroneously, *Thompson's Seedless*—from which the seedless raisins are cured) is most important. It ripens about midseason. Color light yellowish green, flushed when fully ripe. Cluster long, fairly loose, and often fairly compact, large, from 6 to 16 inches long; stem 1½ to 2 inches long, medium size, wiry. Pedicel light green, one-third inch long, slender and warty. Berry oblong, above medium size, five-eighths to three-fourths by three-fourths to 1 inch; adherence good; apex large, black, protruding, with prominent oriole ring. Surface smooth, light yellowish green; bloom white; glossy. Skin medium thick, tough. Flesh fairly meaty, moderately firm, fairly juicy. Flavor sweet, with delicious acidity. An excellent dessert, table, shipping, wine, and raisin grape. Vine a strong, long grower, light brown, long jointed, slender; canes long. Leaf thin, light, bright green above, lighter underneath, smooth and shiny, sharply serrated. An extremely popular and most valuable grape. Should be pruned to canes and trained as stated on pages 7 and 8. (See fig. 3 and Pl. II, fig. 1.) So far, it has shown good congeniality on the following stocks, in the order named: Riparia × Rupestris 3309; Dog Ridge, Aramon × Rupestris Ganzin No. 1, Riparia × Rupestris 101, Lenoir, Solonis × Riparia 1616.

The Sultanina Rosea, a rose-colored variety of Sultanina, is attracting some attention of late years. It should be pruned and trained like Sultanina.

The Sultana has also been grown to some extent, and although a valuable grape that thrives in a number of localities and under a number of diverse conditions, no large vineyards of it are yet to be found in this country.

Panariti (Pl. VI; synonyms, *Corinthe Rose* and *Passereta rosada*) ripens very early. Color amber. Clusters very long, almost cylindrical, but tapering, frequently enlarged toward end of cluster, often shouldered, straggling, loose; stem 1½ to 2 inches long, of medium size, soft, and fleshy. Pedicel light green, one-fourth to one-third inch, extremely slender. Berry round, very small, not averaging much over one-fourth inch in diameter; surface smooth. Color amber, with whitish bloom. Skin thin. Flesh white, soft, juicy. First crop seedless. Flavor rich and sweet, with characteristic currant flavor. Vine vigorous, stocky, but spreading. Canes thick, long, light brownish, smooth, striped, with internodes 3 to 4 inches long. Leaf irregular, five-lobed; upper side rather dark green with lighter green veins; araneous; under side lighter, slightly whitish with yellowish down; indentations small, angular, rounded, higher than broad; petiolar sinus slightly rounded, irregular, rather small. Does well pruned to spurs and short canes (fig. 2 and Pl. II, fig. 2). To get regular crops, annular incision should probably be practiced. Tests of the variety grafted on a number of resistant stocks have so far shown good congeniality to exist between it and Rupestris St. George, Mourvedre × Rupestris 1202, Aramon × Rupestris Ganzin No. 1, Riparia × Rupestris 3309, Salt Creek, and Dog Ridge, in the order named.

The White Currant (synonyms, *Kischmisch*, *Passerina*, *Passera*, *Passereta*, *Szemer*, *Szem*, and *Corinthusi Aproxzemer*) and the Black Currant (synonyms, *Corinthe Noir*, *Currant grape*, *Patras Currant*, *Zante*, *Raisin de Corance*) are very similar to the Panariti, differing materially from it only in color.

Currants have not so far been grown to any great extent in this country, not because they will not thrive here, but no one has engaged in their culture seriously enough to determine the right way to grow, prune, and train them. Vines of the white variety are scattered about in California, but there are no extensive plantings. These produce a beautiful, semitransparent, seedless raisin of good flavor, but inferior to the Black Zante grown on the mainland of Greece. The Department of Agriculture for some years has made experiments in the growing of currant varieties of grapes on different resistant stocks and practiced on them different methods of pruning and training, with very gratifying results, and strong hopes are entertained of starting and developing this special line of the raisin industry. There seems to be no reason why this country should not

produce the 35,356,000 pounds, or $1,206,000 worth, of currants it has for 10 years been annually importing.

CLIMATIC CONDITIONS IN THE RAISIN BELT.

So ideal are the climatic conditions for the raisin industry, and they have such an important influence in drying raisins and other fruits, that the temperature and rainfall records of Fresno and vicinity, furnished by the Weather Bureau, are herewith given. Table IV shows the seasonal rainfall (in inches) for 15 years.

TABLE IV.—*Rainfall at Fresno, Cal., from June to November, 1900 to 1914.*

Year.	June.	July.	Aug.	Sept.	Oct.	Nov.
1900	Trace.	Trace.	0	0.16	0.33	4.61
1901	Trace.	Trace.	Trace.	.59	.56	.86
1902	Trace.	0	Trace.	0	.42	2.25
1903	Trace.	0	0	0	0	.68
1904	0	0	0	1.78	3.21	.08
1905	0	0	0	Trace.	0	.96
1906	Trace.	Trace.	0	Trace.	0	.73
1907	.24	0	Trace.	Trace.	1.08	0
1908	0	.01	0	.15	.02	.66
1909	.80	0	0	0	.72	2.79
1910	Trace.	Trace.	0	1	.45	.24
1911	Trace.	Trace.	0	.01	.09	.17
1912	Trace.	Trace.	0	.10	.01	.85
1913	.10	.33	Trace.	Trace.	Trace.	1.86
1914	.23	Trace.	Trace.	.22	.26	.11

As to temperature it is noted that in the hottest time of the summer the mercury has risen as high as 115° F. in the shade. The average of the highest daily temperatures is about 100° during July and about 98° in August, while the average of the day and night temperatures for the same months is about 82°. The nights are always much cooler than the days. The coldest weather in winter is 17° F. (above zero). The summers are rainless, and the nights are so free from dew or moisture that a piece of tissue paper, after lying out all night, is crisp and stiff the next morning, without a particle of moisture showing.

The rainfall averages 10 inches a year. The principal rains occur in January and February, with some showers in October. Frequently it rains enough in November to cause considerable damage to partly dried raisins or grapes.

HARVESTING AND PREPARING THE CROP.

Drying is the most ancient and primitive of fruit-preserving methods, the dried fruit containing much more nutritive value in proportion to its bulk than fresh fruit. In the raisin districts of this country grapes are ripe by the middle of August, the season often lasting into November. The average time necessary for drying and curing a tray of raisins is about three weeks, depending on the

weather, the earliest picked grapes drying in 10 days and the later ones often taking four weeks or more.

The method of drying is very simple. The bunches are cut from the vines and placed in shallow trays 2 feet wide, 3 feet long, and 1 inch high (Pl. V, figs. 1 and 2), on which the grapes are allowed to sun-dry, being turned from time to time by simply placing an empty tray upside down on the full one and then turning both over and taking off the top tray. After the raisins are dried they are stored away until they are packed and prepared for shipment. Some of the larger growers, in order not to run so much risk in drying on account of rain, and also to enable them to handle the crop fast enough, have curing houses, where the curing is finished after having been partially done outside.

DIPPING AND SCALDING RAISINS.

The operation of dipping and scalding is designed to accomplish several purposes, namely, to cleanse the fruit, to hasten its drying, and to give the dried fruit a lighter color. In dipping and drying, the fruit, immediately after being cut from the vines, is either dipped in clear water to first rinse it of particles of dust and other foreign matter, or it is taken direct to the scalder and immersed in a boiling alkaline mixture called "legia" (lye) until the grapes show an almost imperceptible cracking of the skin, the operation consuming perhaps from one-fourth to one-half of a minute. This dipping calls for skill on the part of the operator, the duration of the immersion depending on the strength and temperature of the mixture and the condition of the fruit. Desiccation follows the scalding process, which is accomplished on trays (Pl. VII, fig. 1) in the sun, the same as undipped raisins cured entirely by solar heat (Pl. VII, fig. 2). On account of the scald they cure rapidly, and the fruit is also often of lighter color when cured. The following formula has been used at Woodland, Yolo County, for Sultana and Sultanina grapes:

Thirty pounds of English bicarbonate of soda are boiled in 30 gallons of water until dissolved, to which are added 70 gallons of water and approximately one teacupful of genuine olive oil. This mixture is for grapes containing 25 per cent of sugar; should their sugar content be less, more bicarbonate of soda is added. The bicarbonate of soda must be sufficiently strong to remove the bloom of the grape and open the pores of the skin to facilitate drying. The cup of olive oil added forms a thin film on the surface of the solution. This film is preserved while dipping by adding an occasional teaspoonful of oil, the mixture being kept sufficiently warm so that the oil dissolves perfectly and spreads evenly over the surface. Three-fourths of a gallon of olive oil will be sufficient to dip 5 tons of grapes in the mixture as given here. When the solution gets dirty it is renewed.

FIG. 1.—PICKING AND DRYING SULTANINA GRAPES.

FIG. 2.—PICKING AND DRYING MUSCAT GRAPES.

A COMPOUND CLUSTER OF PANARITI GRAPES.

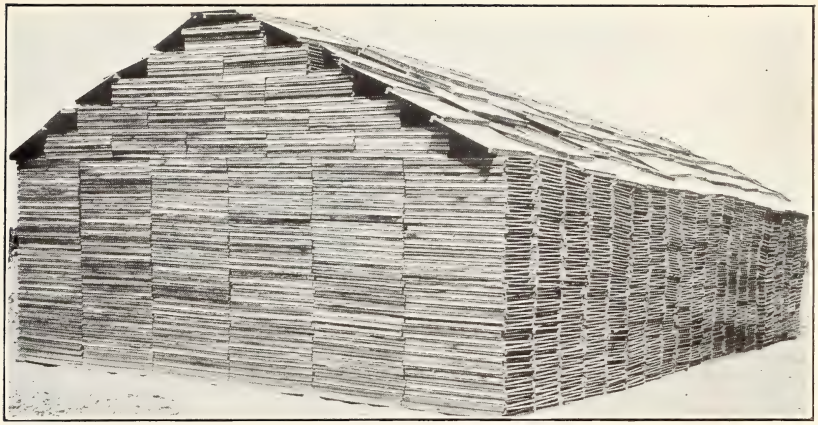


FIG. 1.—A STACK OF RAISIN TRAYS.

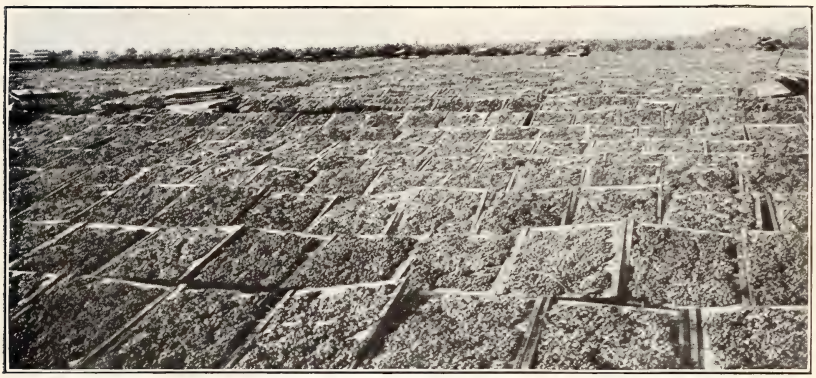


FIG. 2.—PART OF A FIELD OF 11 ACRES OF RAISINS CURING ON TRAYS.

FIG. 3.—HAULING AND STORING RAISINS IN SWEAT BOXES.

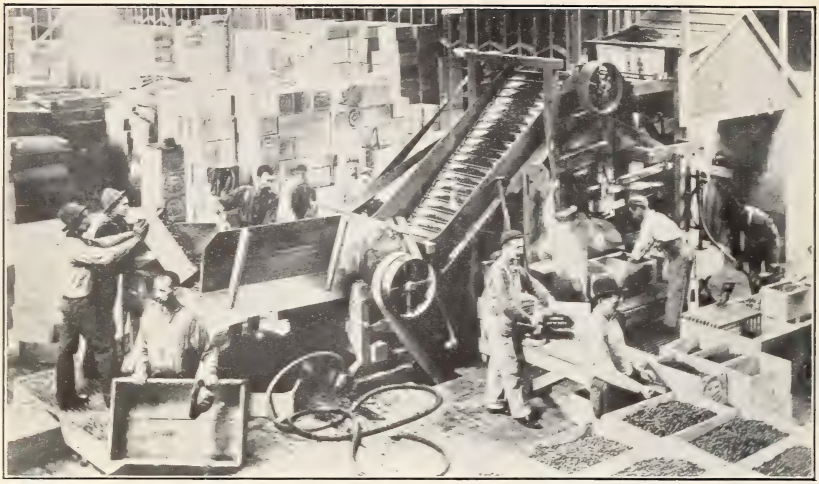


FIG. 1.—STEMMING AND CLEANING RAISINS.

FIG. 2.—RAISIN SEEDERS AND PROCESSERS.

FIG. 3.—A RAISIN SEEDING AND PACKING ESTABLISHMENT.

FIG. 4.—AN UNDERGROUND RAISIN CARRIER.

FIG. 1.—PACKING LAYER RAISINS.

FIG. 2.—PACKING SEEDED RAISINS IN CARTONS.

The following formula has been used for Sultana and Sultanina grapes at Fresno:

Fifteen pounds of "Greenbank's 98-per cent lye" are boiled in 100 gallons of water. This mixture is for grapes containing 25 per cent of sugar. Should their sugar content be less, enough lye is added to remove the bloom and open the pores of the skin of the grapes. After dipping, the grapes are spread on trays and sulphured for 1 to 1½ hours. Observation will show whether it may be necessary to vary this formula a trifle to suit conditions of ripeness and influence of temperature. The length of time required for dipping is ascertained by experience, and differs with the strength of the lye, the heat of the solution, and the thickness of the skins of the grapes.

PACKING RAISINS.[1]

The raisins as received at the packing house are weighed and the loose raisins and those that are to be shipped as dried grapes are immediately run through a stemmer and grader (Pl. VIII, fig. 1), which stems, cleans, and assorts the raisins into three or four different grades, after which they are packed and shipped to various parts of the country, some also being exported. Those producing cluster or layer raisins (if they have not already been equalized) are first stored in the equalizing rooms (Pl. VII, fig. 3). In these rooms the sweat boxes, filled with layers of new raisins, are stacked and left usually from 10 to 30 days, or long enough for the overdried berries to absorb moisture from the underdried ones. This sweating also properly softens and toughens the stems, which prevents their breaking and enables them to hold the berries better. In California, where the climate is so dry, no first-class pack could be made without thus first equalizing the raisins. After having been equalized the raisins are taken out, assorted into the different grades, and placed in trays holding 5 pounds each (Pl. IX, fig. 1). The trays of the same grades are then pressed and stacked away in piles ready for packing.

Pressing the raisins so they look well and so none are burst open is work requiring experience and good judgment. It takes four pressed trays to fill a 20-pound box. The loose raisins that have dropped from the cluster through handling before they were equalized are also graded, the largest, of course, making the choicest pack.

CLASSES OF RAISINS.

Previous to the consolidated organization of the packers the three best grades of raisins on the stems were known as "Imperial," "Dehesia," and "Fancy Clusters," respectively. The California Raisin Growers' Association established classification and grades similar to

[1] Department Bulletin No. 235. "Control of Dried-Fruit Insects in California."

those of the Spanish raisin packers, on which the French trade names are also based. The original Spanish, as well as English terms with which they correspond, and the different grades in descending order of quality are shown in Table V.

TABLE V.—*Different grades of cluster raisins in order of choice as packed in California and the equivalents in the Spanish, French, and English trade.*

Spanish terms.	French terms.	English terms.	California terms.
Imperial	Imperiaux Extra	Extra Imperial Cluster	Six-Crown Cluster.
Imperial Bajo	Imperiaux	Imperial Cluster	Five-Crown Cluster.
Royan Bajo	Royaux	Royal Cluster	Four-Crown Cluster.
Cuarta (4a)	Surchoix Extra	Choicest	Three-Crown Cluster.
Quinta (5a)	Choix Extra	Choice Cluster	Two-Crown Cluster.

The grading is optical, as a result of experience, there being no linear or cubic measurement standard. Thus, a nice cluster with all berries of large size, would be a "Six-Crown Cluster," such being the very finest raisins on the stem. "Five-Crown Clusters" were formerly the "Dehesia" cluster, and "Four-Crown Clusters" were formerly "Fancy Clusters." Grades less than "Four Crown" on the stems (the "Three Crown" and "Two Crown") are known as "Layers," or "London Layers." These are placed in boxes containing 20 pounds net; in half boxes of 10 pounds; and quarter boxes of 5 pounds; and in fancy boxes containing 2½ pounds. Loose raisins, or raisins off the stem, are graded into Two-Crown, Three-Crown, and Four-Crown raisins by being run through screens the meshes of which are thirteen thirty-seconds, seventeen thirty-seconds, and twenty-two thirty-seconds of an inch in size, respectively. The Sultanina (erroneously called *Thompson Seedless*), and the Sultana are packed in 12-ounce cartons, 45 to the case.

SEEDED RAISINS.

The invention of a raisin-seeding machine by George E. Pettit in the early seventies, and its use, has had a wonderful effect on the industry.

Seeded raisins were first put on the market by the late Col. William Forsythe, of Fresno, Cal., who at first found it very difficult to dispose of 20 tons. The output in the last 15 years has increased from 700 tons to 50,000 tons per annum, and their popularity is constantly increasing. In 1900 about 14,000 tons were placed on the market, in 1905 about 21,000 tons, in 1910 about 31,000 tons, and in 1913 about 49,000 tons (Pl. VIII, fig. 2). The seeding machines in present use can turn out 300 tons per day. Seeded raisins are now the most important branch of the raisin industry (Pl. VIII, fig. 3).

A brief outline of how seeded raisins are prepared will prove interesting. The raisins are first exposed to a dry temperature of 140°

F. for three to five hours, after which they are put through a chilling process so that the pedicels can be easily removed, and are then thoroughly cleaned by being passed through cleaning machines. They are then taken by automatic carriers to another room (Pl. VIII, fig. 4), spread out on trays, and exposed to a moist temperature of 130° F. to bring them back to their normal condition. The raisins pass to the seeding machine, where they are carried between rubber-faced rollers and the impaling device of the seeding machine (Pl. VIII, fig. 2), which catches the seeds and removes them from the fruits as they are flattened between the surfaces of the rollers. The impaled seeds are removed from the roller by a whisking device in such a way as to be caught in a separate receptacle. The seeded raisins pass through chutes to the packing tables (Pl. IX, fig. 2) on the floor below.

The seeded or loose raisins are packed in 50-pound boxes; in 1-pound cartons, 36 to the case; in 12-ounce cartons, 45 to the case; and some in bulk in 25-pound boxes.

Information has recently been sent out to the effect that the California Associated Raisin Co. is arranging to do away with the grades in seeded raisins, so there will be only one grade. This contemplates using all of the Three Crown, the smallest of the Four Crown, and the best of the Two Crown in one blended grade.

From the seeds, formerly used as fuel, a number of by-products are now made.[1]

The seeds and pedicels removed from the raisins in seeding vary from 10 to 12 per cent of the original weight of the raisins, according to their conditions and quality.

The grading, seeding, facing, and packing have become separate branches of the industry, and the work is nearly all done by especially trained women, who have become experts at it. The establishments in which this work is done furnish employment for over 5,000 persons. The aggregate pay roll each month during the season is between $200,000 and $350,000.

[1] See Yearbook Separate 354, entitled "Some Uses of the Grapevine and Its Fruit," and Bureau of Plant Industry Bulletin 276, entitled "The Utilization of Waste Raisin Seeds."

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